

Residential Property

Arsenic and Lead

Soil Sampling Guidance




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Background

This Soil Sampling Guidance is one of a series of guidance documents developed to help residents characterize arsenic and lead concentrations in soil for the purposes of reducing exposure to these common soil metal contaminants. Guidance documents are also available for soil sampling on Child-use properties and Commercial properties. Simplified brochures are available for Residential and Child-use properties. Contact the Department of Ecology to obtain copies of these materials.

Purpose

This Soil Sampling Guidance was prepared for people who are interested in identifying ways to reduce exposure to arsenic and lead in soil at their home. It explains how homeowners, tenants, and landlords can collect and analyze soil samples from existing residential properties. This guidance is not meant to fulfill sampling requirements associated with hazardous waste cleanup laws.



Soil sampling is presented as a three-step process.

- **Step 1:** Planning the Sampling – The first step is planning the sampling - deciding where and how to collect soil samples at your home.

- **Step 2:** Sample Collection Methods -- The second step is actual sample collection by you.

- **Step 3:** Having the Samples Analyzed -- The third step is getting the sample analyzed by a private laboratory.

You can use the laboratory results to help manage potential exposure to arsenic and lead in the soil. The sampling approach provides a quick way to see whether arsenic or lead are present and may pose a health concern.

How will soil sampling help me?

There are a number of relatively simple actions that you can take to prevent exposure to arsenic and lead in soil. What actions you take may depend on the amount and location of arsenic and lead in soil on your property. Past studies have shown that the amount of arsenic and lead can be quite variable – that is, even samples taken close together can have very different results. This may be especially true in residential areas where landscaping, construction, gardening, or other actions have resulted in soil excavation or movement. Because soil testing results can be so variable, you cannot reliably predict soil concentrations on your property based on larger studies or even results from your neighbor's property. Sampling is the only reliable way to tell what soil concentrations are on your property. Once you know the location of any elevated levels of arsenic or lead in soils on your property, you and your family can take steps to reduce contact with those soils.



STEP 1: Planning the Sampling

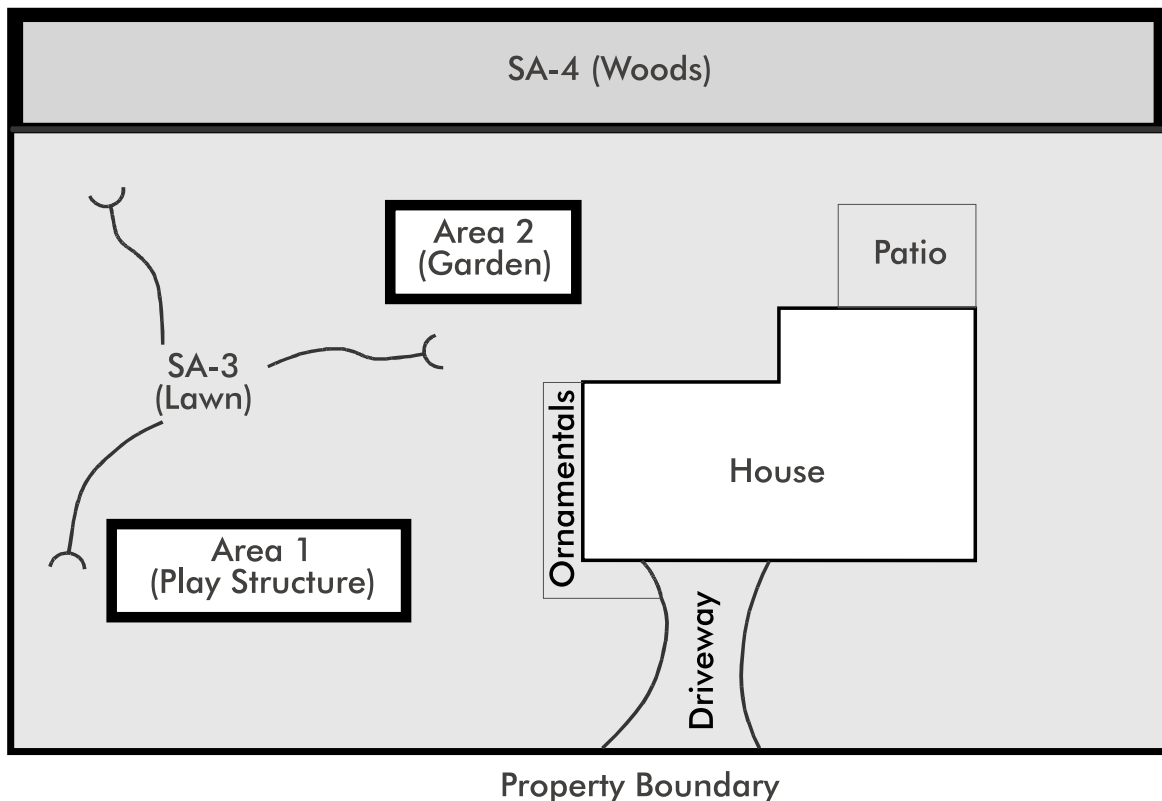
Where do I collect the samples?

If your property is affected by arsenic and lead contamination, the concentration of arsenic and lead in soil on your property will vary from one location to the next. The cause of the variability is due to a number of factors including the source of contamination (i.e., smelter, pesticide use, or automobile emission); topography; climate; and past land use practices that cause

soil disturbance or mixing. Consequently, sampling in one area will not necessarily provide reliable information on another area.

To characterize your property, you will need to collect samples from different parts of your property. An efficient way to do this is to divide your property into areas prior to collecting samples. The purpose of defining separate areas is to group soil samples together from areas of your property with similar characteristics.

Figure 1: Example Areas for a Residential Property



Because the main concern is exposure to contaminated soil, you should divide your property into areas based on exposure potential. Three important questions to ask are:

- Where is exposed dirt?
- Where do children usually play?
- Where do people spend the most time?

Common areas of high exposure are child play areas or gardens. Typical low-exposure potential areas are lawns or brushy/wooded areas. An example of a residential property segregated into areas for soil sampling is shown in *Figure 1*.

Each property will have different characteristics and be used in different ways. It is up to each homeowner, tenant, or landlord to make informed decisions about how to divide their property into representative areas. Obviously, the maximum size of a area for a residential homeowner is the property boundary. For large parcels, a area should be limited to a maximum of 2 acres. The size of high-exposure potential areas (such as a child play area) should not be larger than about a tenth of an acre (equivalent to an area of about 40 feet by 100 feet). If you suspect lead-based paint has been used at your property, you may want to define the immediate area (approximately 10 feet from the house) around the perimeter of the house as a separate area. If you suspect arsenic-treated wood has been used at your house, you may want to define the immediate area around the treated wood structure as a separate area.

Healthy Sampling Behaviors:

- Wear Gloves
- Limit dust by dampening soil or wearing a dust mask
- Wash hands and face after sampling
- Wash soil-laden clothes separately

How many samples should I collect?

The average soil concentration over an area is the most important characteristic for evaluating potential long-term exposure. Because there can be wide variations in arsenic and lead soil concentrations, it is necessary to collect more than one sample from a area to get a reliable estimate of the average soil concentration. In general, more samples collected at different locations within an area will provide a better estimate of the average. Ecology recommends collecting a minimum of four samples per area for small areas; the number of samples should increase for large areas. For high-exposure areas where children play, a minimum of eight samples is recommended for the corresponding area. As a general rule, it is important to prioritize sampling resources toward high-exposure areas. If your resources are limited, high-exposure areas should be sampled first.



A minimum of four samples should be collected from each separate area. Sample locations should be selected to represent good spatial coverage within each area. A simple way to achieve this goal is to separate each area into approximately equal-sized blocks. Collect a single sample from the approximate center of each block. Keep in mind that the sample location should generally be representative of the area as a whole. For example, if you sample near older buildings or wood play structures, your sample results could be influenced by lead-based paint or arsenic-treated wood impacts. An example of appropriate sampling locations for different residential property areas is presented in *Figure 2*.

Increasing the number of samples collected from an area provides a better estimate of soil concentration, but has the disadvantage of increasing laboratory analytical cost. Laboratory analytical cost can be reduced by mixing individual samples together from different locations within an area into a single individual (discrete) sample for analysis. This is called compositing, and gives an “average” result for all the soil that was mixed into the sample. For example, if four samples are collected to characterize an area, a reasonable estimate of the average concentration can be obtained at a reduced cost by compositing (mixing) the four samples into a single sample prior to laboratory analysis. Compositing is demonstrated schematically in *Figure 3*.

Area 4 (Woods)

Area 2 (Garden)

Back Yard 1

Back Yard 2

Area 3 (Lawn)

Lawn

Area 1 (Play Structure)

Ornamentals

House

Patio

Side Yard

Driveway

Front Yard 1

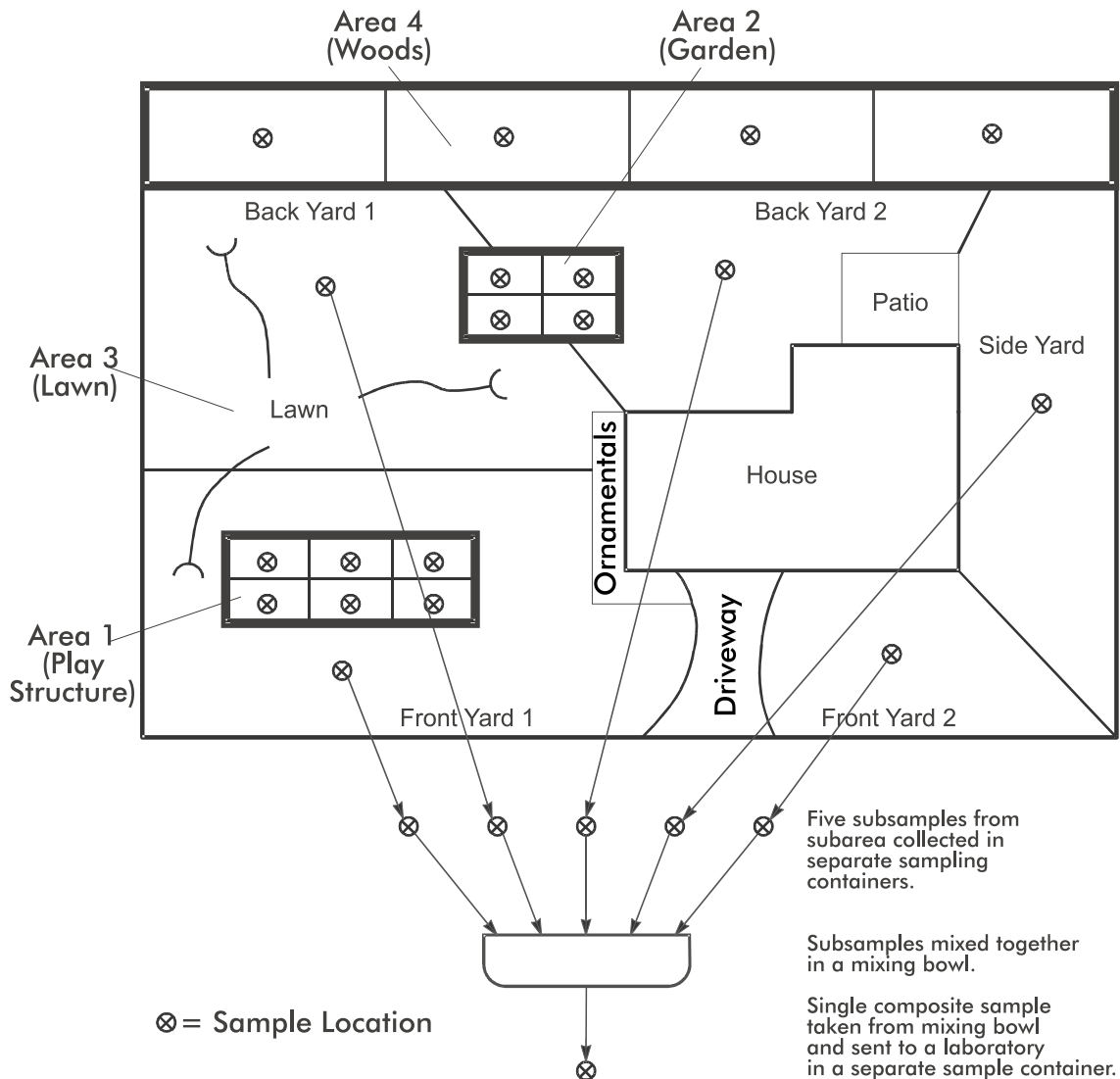
Front Yard 2

⊗ = Discrete Sample Location

The decision to composite is the choice of the property owner or user. The composite sample result provides an acceptable estimate of average soil concentration for evaluating exposure. It does not provide information on the variability of the contamination or whether some parts of an area have higher concentrations than other parts. If you are

interested in a more comprehensive understanding of arsenic and lead concentrations on your property, you should analyze each sample individually. Also, discrete sample results may be required if the data are to be used to show compliance with the state's cleanup law, the Model Toxics Control Act (MTCA.)

Figure 3: Example of a Composite Sample for Area 3: Lawn



How deep should I sample?

Under most residential scenarios, exposure to soil arsenic and lead is primarily from the surface soil layer. Therefore, it is recommended that you collect your soil sample from the surface to a depth of 6 inches. Your sample should consist of soil: avoid collecting organic debris or gravel. Clear or cut away grass, gravel, wood chips, or other similar materials prior to collecting your sample.

Keep in mind that collecting and analyzing a soil sample from the upper 6 inches of the soil column will provide a good estimate of an individual's likely exposure to arsenic and lead. The test result will not necessarily provide a good indication of deeper soil contamination, should it also exist on your property.



Do I have to sample for both arsenic and lead?

A number of studies have been completed to evaluate the characteristics of area-wide soil contamination. If the source of contamination is from historical smelter discharges or lead arsenate pesticide application, soil with elevated arsenic concentrations will also likely have elevated lead concentrations, though arsenic is believed to represent the greater health concern. If the source of contamination is automobile leaded gas emissions or lead-based paint, then only lead will be elevated. If the source is treated wood, then only arsenic will be elevated.

It is recommended that soil samples be analyzed for both arsenic and lead to get a clearer picture of soil contamination impacts on your property. If costs are a concern, it may be acceptable to collect a sample just for arsenic if the suspected source is from historical airborne smelter deposition, lead arsenate pesticide application, or treated wood. In these circumstances, if arsenic concentrations are low, lead concentrations are also likely to be low.

Step 1 Summary:

- Divide your yard into areas based on potential for exposure to soil.
- Collect a minimum of four samples from each small area – more for larger areas.
- Composite the samples or keep them separate, depending on cost constraints, potential future use of the data (i.e., MTCA compliance), and level of detail you want.
- Collect samples evenly throughout the area.
- Sample to a depth of 6 inches.
- Sample for arsenic and lead.

STEP 2: Sample Collection Methods

Once you have planned your sampling, the soil samples are relatively easy to collect. The following steps provide a cost-effective way to get good quality and representative samples:

1. Mark your sample locations with stakes or flagging tape before you begin.

Prepare a site diagram showing where samples were collected – show measured distances and directions from site landmarks.

2. Assemble the necessary equipment:

- Shovel, trowel, or bulb planter
- Clean stainless-steel or plastic spoon
- Permanent marking pen
- Small ZipLoc™ plastic bags or glass sampling containers (about 4 ounces in size; you can get these from the laboratory)
- Paper towels or wash bucket and scrub brush
- Large stainless-steel, plastic, or glass bowl (if compositing)

3. Collect the soil sample:

- Using the permanent marker, label a ZipLoc™ bag or glass container with the following minimum information:
 - Unique sample identifier (i.e., SS1A for soil sample A from area 1)
 - Your name
 - Date
 - What you want to be analyzed (arsenic and lead).
- Clear away any surface debris or grass mat layer.

- Dig a 6-inch deep hole with your shovel, trowel, or bulb planter.
- Using the spoon, scrape fresh soil from the sides of the hole and fill up the plastic bag or the jar. Avoid or discard soil pebbles and rocks. Be sure to collect soil from throughout the entire depth interval of 6 inches.
- Either discard the spoon or clean it using a paper towel or wash bucket and scrub brush. If the spoon is to be used again, it should be free from any visible dirt.
- Securely seal the sample jar or ZipLoc™ bag.

4. If you are compositing:

- First, collect all individual samples (as described above) from an area. Then put equal amounts of soil from each sample directly into the large bowl.
- Thoroughly mix the soil.
- Using the spoon, fill up the plastic bag or the jar with a portion of the mixed soil.
- Discard remaining soil.

5. Catalog all soil samples on a sheet of paper.

Form 1 is included at the end of this guidance for this purpose. Indicate which samples are composites. Store the samples together in a large ZipLoc™ bag, box, cooler, or similar container with a copy of the sample inventory sheet for reference.

STEP 3: Getting the Samples Analyzed

How are the samples analyzed?

The levels of arsenic and lead are determined by sending your soil samples to a laboratory that has the capability to perform metals analyses in soil.

You should transport the samples to the laboratory as soon as convenient after the samples have been collected. The samples can be delivered to the laboratory or shipped using a parcel service. The samples should be stored in a cool, dark place and be given to the laboratory within one week. Once the laboratory receives the samples, they should be able to perform the analysis and report the results to you within 3 to 4 weeks.

Choose an accredited laboratory to analyze the samples. The laboratory can use a variety of methods to analyze for total arsenic and lead. It is recommended that you request the samples be analyzed by either of two methods:

- *Arsenic*: SW 846 Methods 6010, 6020, or 7060
- *Lead*: SW 846 Methods 6010, 6020, or 7421

Prior to analysis, you should ask the laboratory to thoroughly mix each individual sample. The size of soil in the sample should be less than 2 millimeters (2 mm) or about a tenth of an inch. If the soil grain size appears to be greater than 2 mm, you should ask the laboratory to screen the samples to remove all soil and debris in the sample greater than 2 mm. This may result in an extra cost. Alternatively, you can screen the samples yourself with a kitchen strainer.



The laboratory should report the sample concentrations in units of milligrams per kilogram (mg/kg) or parts per million (ppm) (these two are equivalent to each other). Ask the laboratory to screen the samples (if necessary) and to report the results on a dry-weight basis.

Finally, the samples must be analyzed so that very low concentrations can be determined accurately. When giving the samples to the laboratory, they should be instructed that the analytical reporting limits should be no greater than 5 ppm arsenic and 10 ppm lead.



How do I find an appropriate analytical laboratory?

Analytical laboratories are listed in the yellow pages. You do not necessarily need to use a lab near to your home, however, because many labs can work with you through the mail. Only a relatively small subset of laboratories is capable of analyzing metals in soil. When you talk to the laboratory you should ask the following questions:

- Do they have the capability to analyze arsenic and lead in soil by methods 6010, 6020, 7060 (arsenic only) or 7421 (lead only)?
- Will they be able to screen the sample to 2 mm if necessary?
- Can you mail samples to them?
- How much will it cost?
- How long will it take?

If the answer to the first two questions is yes, the laboratory should have the capabilities of providing you with an accurate soil sample analysis.

Ecology maintains a list of laboratories that are accredited by the state to perform soil analyses using methods 6010, 6020, 7060 (arsenic only) and 7421 (lead only.) This web site, <http://www.ecy.wa.gov/programs/eap/labs/srchmain.htm>, may help you locate an appropriate laboratory to complete your sample analyses. If you have questions about using this website or would like Ecology to send you a current list of labs, please contact us at the numbers listed on page 12.

Summary of Steps 1-3

STEP 1: Planning the Sampling

- Divide your yard into areas based on potential for exposure to soil.
- Collect a minimum of four samples from each small area – more for larger areas.
- Composite the samples or keep them separate, depending on cost constraints, potential future use of the data (i.e., MTCA compliance), and level of detail you want.
- Collect samples evenly throughout the area.
- Sample to a depth of 6 inches.
- Sample for arsenic and lead.

STEP 2: Sample Collection Methods

- Mark your sample locations with a stake or flagging tape.
- Prepare a site diagram that shows where samples were collected.
- Assemble the necessary equipment:
 - Shovel, trowel, or bulb planter
 - Clean stainless-steel or plastic spoon
 - Permanent marking pen
 - Small ZipLoc™ plastic bags, or glass sampling containers (about 4 ounces in size; you can get these from the laboratory)
 - Paper towels, or wash bucket and scrub brush.
 - Large stainless-steel, plastic, or glass bowl (if compositing).
- Collect the soil sample:
 - Using the permanent marker, label a ZipLoc™ bag or glass container with the following minimum information: *Unique sample identifier*; (i.e., SS1A for soil sample A from area 1); *Your name*; *Date*; *What you want to be analyzed* (arsenic and lead).
 - Clear away any surface debris or grass layer.

- Dig a 6-inch deep hole with your shovel, trowel, or bulb planter.
- Using the spoon, scrape fresh soil from the sides of the hole and fill up the plastic bag or the jar. Avoid or discard soil pebbles and rocks. Be sure to collect soil from throughout the entire depth interval.
- Either discard the spoon, or clean it using a paper towel or wash bucket and scrub brush. If the spoon is to be used again, it should be free from any visible dirt.
- Securely seal the sample jar or ZipLoc™ bag.
- If you are compositing:
 - First, collect all *individual* samples from an area. Then put equal amounts of soil from each sample directly into the large bowl.
 - Thoroughly mix the soil.
 - Using the spoon, fill up the plastic bag or the jar with the mixed soil.
 - Discard remaining soil.
 - Catalog all soil samples on a sheet of paper. Form 1 is included inside the back cover of this booklet for this purpose. Indicate which samples are composites. Store the samples together in a large ZipLoc™ bag, box, cooler, or similar container with a copy of the sample inventory sheet for reference.

STEP 3: Having the Samples Analyzed

- Instruct the laboratory to:
- Screen samples to 2 mm if necessary.
 - Report on dry-weight basis.
 - Report in units of mg/kg or ppm.
 - Use either of these methods: 6010, 6020, 7421 (*lead*) or 7060 (*for arsenic only*).
 - Analyze with analytical reporting limits no greater than: *arsenic*: 5 ppm, *lead*: 10 ppm.

Contact Information:

Washington State Department of Ecology
(<http://www.ecy.wa.gov/org.html>)

Contact Information:

- Northwest Region: 425-649-7000*
- Southwest Region: 360-407-6300*
- Central Region: 509-575-2490*
- Eastern Region: 509-329-3400*
- Headquarters: 360-407-7170

Three general sources of information on soil arsenic and lead impacts are Ecology, the Seattle-King County Health Department, and the Tacoma-Pierce County Health Department:

- Ecology: http://www.ecy.wa.gov/programs/tcp/area_wide/area_wide_hp.html

- Ecology: http://www.ecy.wa.gov/programs/tcp/sites/tacoma_smelter/lablist.htm

- King County: <http://www.metrokc.gov/health/tsp/arsenic.htm>

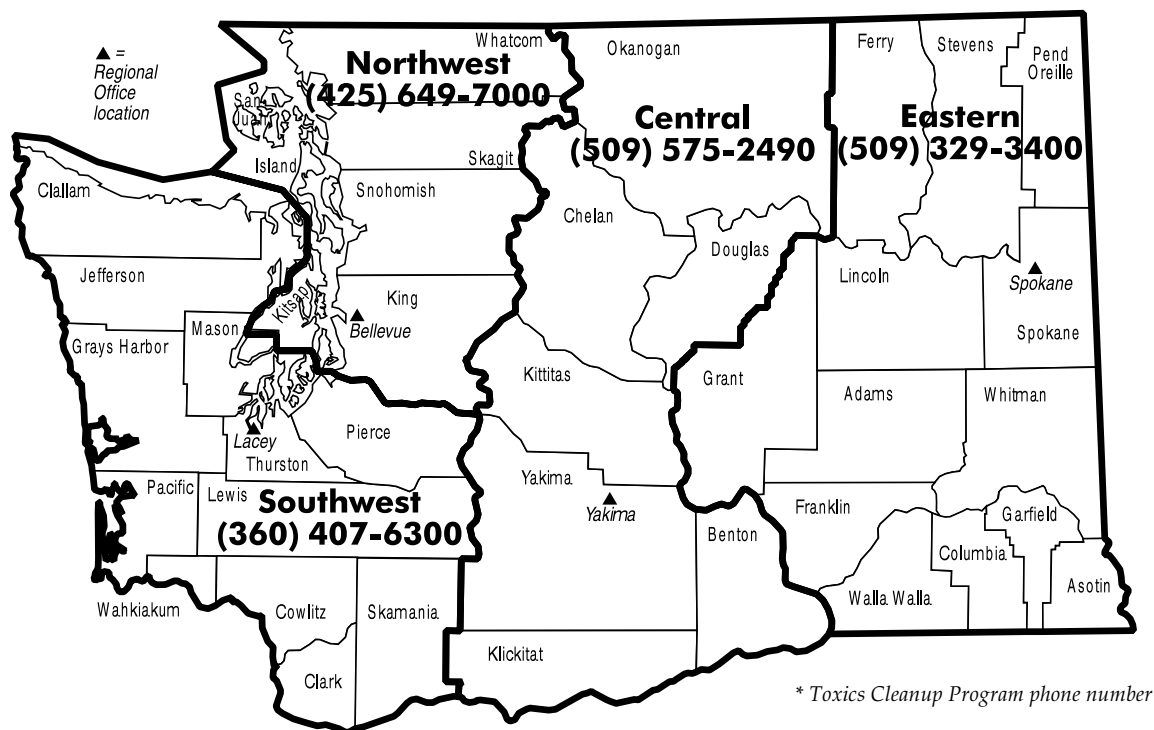
- Pierce County: <http://www.tpchd.org/eh/arsenic/arsenic.htm>

- The State Department of Health (WDOH) also has information about lead in soil. The WDOH fact sheet discusses health effects and ways to minimize exposure to children. The WDOH web site is:

<http://www.doh.wa.gov/Topics/Childhood%20lead%20Poisoning.htm>

The above information is available online at your local public library.

Figure 4: Ecology's Regional Offices



Sample Inventory Sheet

of

Date

[illegible]

Instructions to laboratory: ① Sieve samples to 2 mm prior to analysis if requested.

② Report results on dry weight basis in ppm or mg/kg.

③ Sample analytical reporting limits are 5 ppm arsenic; 10 ppm lead.

④ Perform analysis by methods 6010, 6020, 7060 (for arsenic only) or 7421 (for lead only.)

As = Arsenic Pb = Lead.

Department of Ecology

Toxics Cleanup Program

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